

**REMARKS**

Claim 1 has been amended to recite that the fluid reactivating agent comprises a source of a hydride ion and that the hydride ion is transferred from the fluid reactivating agent to the at least one fouling agent. Claim 38 has been amended to recite that the fluid reactivating agent comprises a hydride ion and that the hydride ion is transferred from the fluid reactivating agent to the at least one fouling agent. Support for the amendments is found in the as-filed application at least paragraphs [0043] and [0071]. Claims 2-20, 39, 40, 43, and 44 have been amended to improve antecedent basis. Claims 24, 26, 27, and 29-31 have been amended to correct claim dependencies. New claims 45 and 46 have been added and recite subject matter previously recited in claims 1 and 38. No new matter has been added.

The Final Office Action mailed March 15, 2007, has been received and reviewed. Claims 1-31 and 38-44 are currently pending in the application. Claims 1-31 and 38-44 stand rejected. Applicants have amended claims 1-20, 24, 26, 27, 29-31, and 38-44, canceled claim 21, added new claims 45 and 46, and respectfully request reconsideration of the application as amended herein.

**35 U.S.C. § 103(a) Obviousness Rejections****Obviousness Rejection Based on U.S. Patent No. 5,326,923 to Cooper *et al.* in view of the American Chemical Society publication to Seapan *et al.***

Claims 1-31 and 38-44 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 5,326,923 to Cooper *et al.* ("Cooper") in view of American Chemical Society publication to Seapan *et al.* ("Seapan"). Applicants have canceled claim 21, rendering moot the rejection as to these claims. Applicants respectfully traverse this rejection as to the remaining claims, as hereinafter set forth.

M.P.E.P. 706.02(j) sets forth the standard for an obviousness rejection:

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on

applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The obviousness rejection of claims 1-20, 22-31, and 38-44 is improper because the cited references do not teach or suggest all of the claim limitations and do not provide a motivation to combine to produce the claimed invention.

Cooper teaches a solvent extraction process for regenerating a solid acidic catalyst that is used to alkylate an isoparaffin with an olefin to produce an alkylate. Cooper at column 6, lines 7-12 and column 6, line 35-column 7, line 1. The alkylation reaction involves contacting the isoparaffin with the olefin in the presence of the solid acidic catalyst and a Lewis acid at a temperature ranging from -30°C to 50°C to produce the alkylate. *Id.* at column 9, lines 24-35. The isoparaffin has from four to ten carbons, such as isobutane. *Id.* at column 9, lines 53-57. The olefin has from three to five carbons. *Id.* at column 9, lines 57-59. A mixture of highly branched alkanes is produced by the alkylation reaction. *Id.* at column 9, lines 60-61. After being deactivated by residue produced by the alkylation reaction, the solid acidic catalyst is regenerated by contacting the solid acidic catalyst with a liquid solution including a solvent, such as SO<sub>2</sub>, oxygenates, such as C<sub>1</sub>-C<sub>4</sub> alcohols, ketones, and aldehydes, nitriles, or phenols. *Id.* at column 10, lines 29-38. The liquid solution removes a portion of the reaction residue produced by the alkylation reaction. *Id.* at column 10, lines 56-58. The regenerating process is performed at a temperature of between 0°C-50°C. *Id.* at column 11, lines 5-7.

Seapan teaches regenerating a catalyst using a supercritical fluid extraction technique. Seapan at p. 79. Tetrahydrofuran, pyridine, SO<sub>2</sub>, and CO<sub>2</sub>, were tested under supercritical conditions to determine their respective abilities to remove coke from the catalyst. *Id.* at p. 82. Of the tested solvents, pyridine, SO<sub>2</sub>, and CO<sub>2</sub> effectively removed coke from the catalyst. *Id.* at p. 83-88.

Cooper and Seapan, alone or in combination, do not teach or suggest all of the limitations of claim 1. Specifically, the cited references do not teach or suggest the limitation of "contacting the catalyst with a fluid reactivating agent comprising a source of a hydride ion at or above a critical point of the fluid reactivating agent," as recited in claim 1. Cooper does not teach or suggest this limitation because the liquid solution used to regenerate the solid acidic catalyst includes SO<sub>2</sub>, C<sub>1</sub>-C<sub>4</sub> alcohols, ketones, aldehydes, nitriles, or phenols, none of which includes a source of a hydride ion. In addition, since the solid acidic catalyst of Cooper is contacted with a

liquid solution to conduct the regeneration, the liquid solution is, by definition, not at or above its critical point. Since Cooper does not teach or suggest a fluid reactivating agent comprising a source of a hydride ion source and does not teach or suggest that the fluid reactivating agent is at or above its critical point, Cooper does not teach or suggest the above-mentioned limitation.

The Examiner relies on the mention of isobutylene, isobutane, and benzene in Cooper as teaching compounds “which would be capable of transferring a hydride ion.” Office Action of March 15, 2007, p. 2-3. However, the benzene mentioned at column 3, lines 64-65 is a starting material for the alkylation reaction, which is conducted at a temperature that maintains the reaction in a liquid phase. Cooper at column 1, lines 43-46. Therefore, even assuming *arguendo* that benzene is “a source of a hydride ion” (which Applicants do not concede), the benzene is not at or above its critical point when the benzene contacts the solid acidic catalyst of Cooper. The Examiner also relies on column 5, lines 1-3 and column 10, lines 61-63 of Cooper as teaching benzene. However, after a close review of these sections of Cooper, Applicants respectfully submit that these sections do not teach or suggest benzene.

Similarly, the isobutylene (column 9, line 35) and isobutane (column 9, lines 41-43 and lines 56-57) taught in Cooper are starting materials for the alkylation reaction, which is conducted at a temperature between -30°C and 50°C. During the alkylation reaction, the starting materials are maintained in a liquid phase and, therefore, are not at or above their respective critical points. Cooper, column 9, lines 38-41. Furthermore, nothing in Cooper teaches or suggests that the isobutylene and isobutane are at or above their respective critical points.

Seapan also does not teach or suggest the above-mentioned limitation because pyridine, SO<sub>2</sub>, or CO<sub>2</sub> do not comprise a source of a hydride ion. As such, Seapan necessarily does not teach or suggest contacting a catalyst with a fluid reactivating agent comprising a source of a hydride ion at or above the critical point of the fluid reactivating agent.

The Examiner appears to rely on the mere mention of isobutane, isobutylene, and benzene in Cooper as teaching or suggesting the above-mentioned limitation of claim 1. However, the Examiner’s argument overlooks the fact that the above-mentioned limitations of claim 1 are method limitations and recite elements other than isobutane, isobutylene, and benzene.

Cooper and Seapan, alone or in combination, also do not teach or suggest the limitation of “transferring the hydride ion from the fluid reactivating agent to the at least one fouling agent,” as recited in claim 1. Since neither reference teaches or suggests a fluid reactivating

agent comprising a source of a hydride ion and contacting a catalyst with such a fluid reactivation agent, the cited references do not teach or suggest transferring a hydride ion from the fluid reactivating agent to the at least one fouling agent. Since the liquid solution of Cooper does not include a source of a hydride ion, Cooper does not teach or suggest transferring a hydride ion from its liquid solution to the residue on the solid acidic catalyst. The Examiner acknowledges that Cooper does not teach or suggest this limitation. Office Action of March 15, 2007, at p. 3. Similarly, since Seapan teaches using pyridine,  $\text{SO}_2$ , or  $\text{CO}_2$  to remove coke from its catalyst, and since none of these compounds includes a source of a hydride ion, Seapan does not teach or suggest transferring a hydride ion from these compounds to the coke.

The cited references also do not provide a motivation to combine to produce the claimed invention. To provide a motivation or suggestion to combine, the prior art or the knowledge of a person of ordinary skill in the art must “suggest the desirability of the combination” or provide “an objective reason to combine the teachings of the references.” M.P.E.P. § 2143.01. The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. *Id.* (emphasis in original).

The Examiner acknowledges that Cooper “fails to disclose reaction with at least some of the impurities” and relies on Seapan as teaching the limitation of “reacting the fluid reactivating agent with the at least one fouling agent.” Office Action of March 15, 2007, p. 3. The Examiner states that “it would have been obvious to one of ordinary skill in the art at the time the invention was made to use the reaction of Seapan in the regeneration process of Cooper because Cooper refers to Seapan’s disclosure of supercritical  $\text{SO}_2$  to remove impurities . . . and Cooper [sic] [Seapan] discloses his treatment with supercritical reactive and strong solvents to break down macromolecular structures.” *Id.*

However, Cooper’s reference to Seapan does not suggest the desirability of the combination or provide an objective reason to combine the teachings to produce the claimed invention. As described above, the regeneration processes of Cooper and Seapan are performed under different temperature and pressure conditions. The regeneration process of Cooper is performed at  $0^\circ\text{C}$ - $50^\circ\text{C}$  with a liquid solution, while the regeneration process of Seapan is performed with pyridine,  $\text{SO}_2$ , or  $\text{CO}_2$  under supercritical conditions. Since it is known in the art that solvents have different properties at noncritical conditions versus critical conditions (see, for

example, Seapan at p. 81-82), one of ordinary skill in the art would not be motivated to combine the solvent extraction regeneration process of Cooper with the supercritical fluid extraction regeneration process of Seapan to produce the claimed invention.

Furthermore, even if Cooper and Seapan were combined, the claimed invention would not be produced because the catalyst would not be contacted with a fluid reactivating agent comprising a source of a hydride ion. As previously discussed, neither Cooper nor Seapan teaches or suggests contacting their respective catalysts with a fluid reactivating agent comprising a source of a hydride ion at or above its critical point. At best, the combination of Cooper and Seapan would result in contacting the solid acidic catalyst of Cooper with a liquid solution of pyridine, SO<sub>2</sub>, or CO<sub>2</sub>. Alternatively, the combination of Cooper and Seapan would result in contacting the catalyst of Seapan with supercritical SO<sub>2</sub>, oxygenates, such as C<sub>1</sub>-C<sub>4</sub> alcohols, ketones, and aldehydes, nitriles, or phenols.

Claims 2-20 and 22-31 are allowable, *inter alia*, as depending from an allowable base claim. New claim 45 is also allowable, *inter alia*, as depending from an allowable base claim.

Claim 4 is further allowable because the cited references do not teach or suggest providing the catalyst at least partially deactivated by at least one hydrogen deficient fouling agent. The Examiner argues that Cooper teaches this limitation because "Cooper '923 discloses isobutylene." Office Action of March 15, 2007, p. 3. However, the isobutylene in Cooper is one of the starting materials of the alkylation reaction and is not the reaction product residue.

Claim 5 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising a solvent that reacts with the at least one fouling agent to facilitate removal, in total or in part, of the at least one fouling agent from a surface of the catalyst.

Claim 7 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising an alkane having at least one tertiary carbon atom or a compound that can be isomerized in the presence of the catalyst to form at least one tertiary carbon atom, the fluid reactivating agent at or above its critical point. The Examiner states that Cooper teaches this limitation because Cooper "discloses isobutane and 750 psig." Office Action of March 15, 2007, p. 4. However, the section of Cooper relied upon by the Examiner in support of this assertion relates to the alkylation process, not to the regeneration step of Cooper. Furthermore, since Cooper teaches that the pressure during the alkylation reaction

maintains the reactants in a liquid phase, Cooper does not teach or suggest that the isobutane is at or above its critical point.

Claim 8 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising a compound selected from the group consisting of isobutane, isopentane, and mixtures thereof for similar reasons as claim 7.

Claim 9 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising a compound selected from the group consisting of n-butane, n-pentane, and mixtures thereof for similar reasons as claim 7.

Claim 10 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising an aromatic compound selected from the group consisting of benzene, toluene, ethylbenzene, and mixtures thereof for similar reasons as claim 7.

Claim 11 is further allowable because the cited references do not teach or suggest contacting the catalyst with the fluid reactivating agent comprising at least one of a dissolved species of hydrogen or oxygen.

Each of claims 12-17 and 19 is further allowable because the cited references do not teach or suggest contacting the catalyst with a fluid reactivating agent comprising a source of a hydride ion at or above a critical point. Seapan does not teach or suggest the limitations in these claims because the solvents taught in Seapan do not include a source of a hydride ion.

Claim 18 is further allowable because the cited references do not teach or suggest contacting the catalyst with isobutane at a pressure in the range of about 200 psig to about 5000 psig for similar reasons as claim 7.

Claim 20 is further allowable because the cited references do not teach or suggest transferring the hydride ion from the fluid reactivating agent to the at least one fouling agent and, therefore, does not teach or suggest stabilizing the at least one fouling agent.

Claim 22 is further allowable because the cited references do not teach or suggest releasing the at least one fouling agent having a molecular weight approximately equal to or greater than the molecular weight of the at least one fouling agent deposited on the catalyst. The Examiner states that it would have been obvious "that a hydride ion has a lower molecular weight than the disclosed solvents of Cooper." Office Action of March 15, 2007, p. 5. However, claim 22 does not recite the molecular weight of the hydride ion or of solvents and does not

recite releasing the hydride ion. Instead, claim 22 recites that the molecular weight of the fouling agent released from the catalyst is approximately equal to or greater than the molecular weight of the fouling agent deposited on the catalyst.

Claims 24 and 25 are further allowable because the cited references do not teach or suggest adsorbing the at least one fouling agent to a solid material (as recited in claim 24) and adsorbing the at least one fouling agent to a solid material selected from the group consisting of alumina, molecular sieves, and activated carbon (as recited in claim 25). The Examiner argues that these limitations are taught because Cooper “discloses zeolites and alumina.” *Id.* However, the Examiner overlooks the remaining language of these method limitations, which recites adsorption of the at least one fouling agent to a solid material, such as alumina, molecular sieves, or activated carbon.

Cooper and Seapan, alone or in combination, also do not teach or suggest all of the limitations of independent claim 38. Specifically, the cited references do not teach or suggest the limitations of “directing a fluid reactivating agent comprising a hydride ion towards at least one catalyst,” “contacting the at least one catalyst with the fluid reactivating agent comprising the hydride ion at or above a critical point of the fluid reactivating agent,” and “transferring the hydride ion from the fluid reactivating agent to the at least one fouling agent” for substantially the same reasons as discussed above for claim 1.

Claims 39-44 are allowable, *inter alia*, as depending from an allowable base claim. New claim 46 is also allowable, *inter alia*, as depending from an allowable base claim.

Claim 43 is further allowable because the cited references do not teach or suggest generating pressure and temperature conditions such that the fluid reactivating agent comprising the hydride ion is at or above a critical point of the fluid reactivating agent and is of sufficient density to dissolve the impurities.

### ENTRY OF AMENDMENTS

The amendments to claims 1-20, 22, 24, 26, 27, 29-31, and 38-44 should be entered by the Examiner because the amendments are supported by the as-filed specification and drawings and do not add new matter to the application.

### CONCLUSION

Claims 1-20, 22-31, and 38-46 are believed to be in condition for allowance, and an early notice thereof is respectfully solicited. Should the Examiner determine that additional issues remain which might be resolved by a telephone conference, the Examiner is respectfully invited to contact Applicants' undersigned attorney.

Respectfully submitted,

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